THE INTERNATIONAL PRELIMINARY CONFERENCE TO FORMULATE REGULATIONS GOVERNING WIRELESS TELEGRAPHY.

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IT is probable that few peaceful international events of recent years have had such a peculiar, as well as important, interest to the world at large as the Preliminary Wireless Telegraphy Conference which was in session at Berlin from August 4th to August 14th last. The importance lies more in the future than in the present, for Wireless Telegraphy is still in that nebulous state which prevents one from fairly judging whether or not it is of such real value as its present condition would indicate. But the real question raised was not whether such and such systems of Wireless Telegraphy should have a monopoly because they were first in the field, but whether the constituted authorities of the various great states were not for the first time brought face to face with the problem (as the head of the French delegation wittily observed) of whether there is not an ethereal and aërial league as well as a marine league, and whether under the new conditions a marine league of three miles is sufficient. Wireless Telegraphy, by utilizing Hertzian ether waves, is the first discovery that has brought this subject to the front; but possibly there may be other waves besides Hertzian that can be used for transmission of information. As regards the air, we may be compelled at no distant time to consider aërial navigation, and whether or not a foreign air-ship is not subject to our laws when it flies over our country, and if so what is the limit of height.

It is a very intangible subject, and in this preliminary confer-

ence the delegates felt all the importance of their mission and the decided inadvisability of doing more than sketching out general lines.

In order to give a broad idea of the conditions involved, it might be well to give a general résumé of the history of Wireless Telegraphy and the circumstances which brought about this preliminary conference.

Some years ago, Professor Hertz discovered the waves which bear his name. They consist simply of vibrations in the ether caused by an electric spark, which can be received by suitable apparatus placed at a distance. It should be noted in this connection that the ether is the somewhat intangible substance that fills all space, while air only immediately covers the globe. Hertz's experiments were confined to the laboratory. Sometime after Hertz's death, Professor Righi discovered the best apparatus (of his day) for making the spark, and also that a certain kind of spark was the best; but it was not until 1890 that Professor Branly discovered the first satisfactory receiver, which consists, in its simplest form, of a short glass tube, the size of a quill, containing a small quantity of metal filings. Marconi was the first to discover the fact that the most satisfactory way of collecting the waves caused by the spark and transmitting them through space, and of receiving them and conveying them to the Branly tube, was to have two upright wires, one at each station. Marconi's discovery gave the clue to practical and useful ranges; he was the first to see the commercial value of Wireless Telegraphy, and the Marconi Company was the first company in the field to exploit the new discovery.

There is no question, in this résumé, of reflecting in any way on the claims of rival inventors. Lodge, Fleming, Muirhead, Fessenden, de Forest, Tesla, Ducretet, Rochefort, Guarini, Popoff, Arco, Brann, Slaby, etc., have all contributed in most material fashion to the present imperfect solution of the problem; and in many cases the patents show that there have been independent discoveries of exactly the same thing in different countries at practically the same time. It is the old story over again that is found in the history of so many inventions: the world being ripe for the idea, the minds of many men in many countries were turned to it at the same instant. Consequently, the future battle of patents is one which is likely to be severe.

The possibility of practical Wireless Telegraphy being established, three questions immediately presented themselves: (1) how to secure secrecy; (2) how to prevent interference; (3) how to obtain range. It may be stated that to-day the practical working range, used between ship and ship at sea and between ship and shore, varies from thirty to forty miles, though the apparatus of the various makers is scheduled to range from 100 to 125 miles. This is because there are so many misstudied phenomena whose effect is not yet thoroughly understood. For example, electric disturbances of the atmosphere such as thunder storms, near or distant, have a marked effect. Sunlight has also a marked effect, but it is not certainly known whether it is light and heat or light without heat. Land is much more difficult to telegraph over than water, which is obvious enough because of the hills which break the waves; but why should fresh water be almost as difficult as land when compared with salt water. Bare rocks and ice are extremely difficult and in Somaliland the desert has up to now presented an insurmountable obstacle.

In order to obtain secrecy, two methods are now being studied. By the first method the sending and receiving apparatus are tuned to a similar wave-length. This matter of electric waves is a very odd one. It is usual to compare these waves to the circles produced in water by throwing in a stone; but the water-wave looks as if it advanced whether it does or not. A better comparison is that to the vibrations of a rope secured at one end and shaken at the other; the waves can be made to vary by the amount of force exerted, and the rope obviously does not advance. Ether waves can be made to vary in the same way by suitable electrical appliances, and laboratory experiments can be made to prove the actual length by arranging a long wire, through which a wave is passing, about the walls and ceiling, and drawing sparks from it at every foot or so. A regular wave of intensity will be shown to exist by the length of sparks extracted; it varies from nothing at the nodal points to, say, three-quarters of an inch at the point of maximum swell.

Theoretically, of course, if two sets of apparatus are using different wave-lengths, their signals will not interfere and careful experiments will show this to be true. At an exhibition before the Conference at Berlin, Count Arco showed two signals being received on different apparatus, and recorded at the same

time, from a distance of one and two miles, respectively, only one mast wire being used at the receiving station. He had arranged for a third at the same time, but the apparatus got out of order before the exhibit, and it was not shown. The two wave-lengths used were of 2,000 and 4,000 feet, respectively. The third length was to have been 1,000 feet. Marconi has made the same public demonstration in Italy with waves of 1,000 feet and 500 feet. Such exhibitions are very remarkable; but it was brought out at the conference by competent authorities that the results are not always reliable. It is to be noted that these wave-lengths are exact multiples of each other. Apparently, if reliable syntony can be obtained, the problem would be solved; but many scientists claim, for various abstruse reasons, that no more than ten different practical wave-lengths can ever be obtained. If this be true, then for a fleet, say, of forty men-of-war something more is wanted for separate communication with the flag-ship.

The second method of obtaining secrecy is simply to have each vessel supplied with a call number or signal, and with an apparatus which will work or switch in on this call and on nothing else. There are several patents which have been taken out on apparatus of this kind, some of them being paper patents, *i. e.*, patents in which the drawing is apparently accurate but which will not work out in metal. One, however, that of Anders Bull, has been tried successfully in the laboratory at Christiania, and is about to be tried practically in the Norwegian navy.

The wave theory is the most scientifically attractive, however; and syntonic arrangements do add greatly to the distance at which wireless telegraphic signalling can be carried on. Moreover, the wave theory holds in so many other fields of research, as in the construction of ships, the transmission of sound, the detonation of explosives, etc., that we may be sure that it will be much more closely studied; but at present one certainly takes the public into one's confidence when one sends a wireless telegraphic message. In last year's British naval manœuvres, the Admiral commanding one of the rival fleets took an ingenious advantage of this fact by making no signals himself but keeping a careful watch of his own receiving instruments. He thus became aware of all the projected manœuvres of his rival and therefore easily defeated him.

So far are we from being able yet to achieve secrecy that there

is sometimes something positively uncanny and Mephistophelian in the way these Hertzian waves betray their supposed masters. Some time ago, a man-of-war was exercising at discovering torpedo-boats with two searchlights. Suddenly, one of the lights commenced to wink or flicker. This seemed all the more strange as its carbons were feeding regularly, and the other light was burning clear under the same current. Presently, some one noticed that there was a certain rhythm about the winks; and, the intervals being marked on paper, a complete Morse dot-and-dash signal revealed itself. It was afterwards learned that two foreign men-of-war, which were out of sight, were exchanging this identical signal by Wireless Telegraphy at that exact time. Here was a new form of receiver accidentally discovered, which happened to be in syntonic harmony, while the neighboring light was entirely devoid of any such qualities.

How to prevent interference is something which, in the present state of Wireless Telegraphy, is reduced simply to arranging such a succession of signals that no two ships will be signalling to a third or to a shore station at the same time. Generally speaking, it may be said that, if A is signalling to B and C to D, A will interfere with C if he is nearer to C than C is to D. The general consensus of opinion at the conference was, that men-of-war and posts for national defence should be quite independent of all regulations.

How to obtain the greatest range is, for ordinary apparatus, to be solved by syntony, as has been already stated, combined with carefully constructed instruments and sensitive coherers (Branly tubes) together with more sensitive relays, which, being actuated by the slightest Hertzian wave modified by the coherer, will switch in a battery strong enough to work a Morse recording apparatus. The receiver—a term which includes the whole receiving apparatus—is at present considered to be the most important part of a Wireless Telegraphic establishment; and many other inventions designed to supersede the Branly tube are now being tried, the most notable being the Castelli coherer where a drop of mercury replaces the metal filings. Very sensitive telephones have also been invented, which give much greater range than filing tubes with Morse recorders; but the objection to them lies in the fact that they do not record. Marconi's greatest ranges have been obtained by the use of a telephone combined with his magnetic

receiver in place of the Branly tube or Castelli coherer. This magnetic receiver is an ingenious device which takes advantage of hysteresis or lag of current in a piece of metal alternately magnetized and demagnetized, and is more sensitive than a filing tube. Among the new receivers that of Professor Fessenden is remarkable in the fact that it depends upon the change of temperature produced in a minute piece of platinum wire by the passage of the Hertzian wave; this change of temperature actuating a very sensitive telephone by modifying the conductivity of the wire. For ships' use, however, filing coherers with Morse recorders are preferred, from the fact that a record on a tape is quite independent of what any man with a telephone thinks that he hears. To reach the extreme ranges obtained by Marconi, it has been found necessary to erect the huge wire-cages at Poldhu, Glace Bay and Cape Cod, so often shown in the illustrated papers. An apparatus of one hundred and fifty horse-power is said to be employed; but the Marconi Company are naturally jealous of their business interests and nothing is known of their exact methods of procedure by any one except the experts of the company, Similar stations of much greater power are proposed at Pisa in Italy, and at some point in Argentina. In the course of his earlier experiments, Marconi demonstrated that a short hollow cylinder of large capacity was almost as good an agent for collecting the waves at each station as mast wires; but he has never had time to develop the subject. It is a matter of extreme importance, and bears upon the much-mooted point as to whether the earth and its water do not really play the most important part in transmitting long-distance signals. The fact that these waves, whatever they are, will go round the curvature of the earth, although the masts are comparatively short, points in the same direction. The importance of using a short cylinder, possibly the funnels of a man-of-war, instead of 150 feet of mast wire, needs no proof when we consider their relative chances of being shot away.

Having discussed the essential requirements of successful Wireless Telegraphy and the present condition of perfection that has been attained in each, it may be well to state the general commercial situation in brief. The present manufacturers of Wireless Telegraphic apparatus for sale are, in the United States, Fessenden, De Forest and The American Marconi Company. In England there are The Marconi Company, Lodge, Muirhead, and

Armstrong & Orling; there are a few others, as in the United States, who make small parts, but no others able to name a price for a complete set. In France, there are Ducretet-Popoff and Rochefort. In Germany there were formerly Slaby, Arco, and Brann-Siemens; but they have now combined into one firm, called "Telefunken." In Russia, Popoff is associated with Ducretet in Paris, who does the manufacturing.

There are only two companies who exploit Wireless Telegraphy, own their own stations and make their own apparatus; these are the Marconi Company and the De Forest Company. There is another company in France called the Compagnie Française de Telegraphic sans Fil; but as the French Government has confiscated the only station erected by them in France, that at Cape La Hague, and has refused authorization for any others, this company can scarcely be said to have an existence in France. It advertises, however, to have received concessions for two stations in Holland, two in Norway, two in Greece, and to have formed a branch company in Spain. All the other individuals and firms mentioned merely manufacture apparatus for sale at a fixed price. The Marconi Company will not sell except for a price, *plus* a royalty for fourteen years, or for a larger price in which the royalty is included, as is the case in their present arrangement with the British Admiralty. It may be remarked that the principal Wireless Telegraphic business to-day is that between ship and ship and between ship and shore; and at the present moment there are only two pay-stations between land and land; these are between the coast of California and the small island of Avalon, and between the islands of Martinique and Guadaloupe, a distance of about one hundred and twelve miles. Shortly after the earthquake had destroyed the cables, the French Government erected these two stations, and they have operated with reasonable satisfaction ever since, the tariff being six cents per word. A Marconi system was successfully established among the Sandwich Islands, but it failed through unreliability caused by lack of skill among the native operators.

As regards the national use of the different kinds of apparatus the situation is as follows:

In Russia, the navy uses Ducretet-Popoff in large numbers; but the post-office and army have a few Telefunken stations for long-distance signalling and army field-work;

In Austria, competitive trials are now being made between French and German manufacturers, the Marconi Company having declined to compete;

In Germany, all departments are supplied with Telefunken apparatus, but not to the same degree; the navy has large numbers; the army a less number for field-service and the Post-Office Department a few; the apparatus is modified by government officials;

In France, the government divides its orders between Ducretet-Popoff and Rochefort, and the relative quantity ordered by the different departments is about the same as in Germany; the apparatus is perfected by government officials;

In Spain, some few experiments have been made with French and German material, but the apparatus preferred is that of de Cervera, a Spanish army officer of distinguished ability;

The Italian Government has a firm contract for all departments with the Marconi Company for fourteen years; the navy has been a very active purchaser for ships and a large number of shore stations are being erected; next to the navy, the post-office has been the most active; and the army is experimenting with Marconi field-stations;

In England, which is the only country, besides Italy and Canada, that has paid money for the Marconi patents before they were tested in the courts, the Admiralty has adopted the Marconi system and given large orders; the apparatus is afterwards perfected by the officials; they have also experimented with French apparatus, and the Post-Office Department and the army are experimenting with Telefunken apparatus, both for stations and field-service.

The smaller European Powers, as well as Mexico and the South-American States, have patronized both French and German manufacturers to a moderate degree for experimental purposes, and Sweden has adopted Telefunken for her navy and bought quite a large quantity of apparatus.

In the United States, the army has experimented with indifferent success with De Forest, Marconi, and Fessenden, and a small quantity of Lodge-Muirhead and Brann-Siemens apparatus has lately been bought for experimental purposes, partly for station and partly for field-work. The navy has bought Ducretet—Popoff, Rochefort, Brann-Siemens, Slaby-Arco, Lodge-Muirhead and De Forest for competitive test. The Marconi Com-

pany would not compete. Slaby-Arco has so far proved the best as regards general practical character and range, and forty-five more sets have been ordered for service. But this range is only 81 sea miles, compared with 125 sea miles in the Baltic with the same apparatus; there is the same relative falling off with all the others, and it appears probable that the electrical conditions of the United States are different from those of Europe.

While on the subject of apparatus, it may be mentioned that the rapidity with which improved detailed apparatus is being invented in Europe is extraordinary. At the Telefunken exhibit, the members of the Conference were shown a new coherer on the electrolytic principle, which does away with the tapper which is so necessary with the Branly tube to instantaneously decohere the metal filings after they have been cohered by the passage of the Hertzian wave. It is true that the Lodge-Muirhead revolving wheel in contact with a bubble of mercury does the same thing; but this is still another and radically different way. They were also shown a miniature Brann-Siemens apparatus for lecture purposes. The whole double set can be placed on a table about four by five feet in size, and the signalling range is about 1,000 feet. Nearly every university in Germany has one; but Toronto is the only city in America that has purchased a set. The price is about one hundred dollars, and as under existing laws they could be imported free of duty as instruments for scientific experiments, they might easily form a valuable auxiliary to the lecture outfit of our numerous colleges, as the subject of Wireless Telegraphy is certain to form a valuable and interesting accession to courses of electrical lectures in the future.

The ground having been cleared, in a somewhat rambling fashion, as regards the existing situation, it will be in order to give the reason for calling the Conference. The Marconi Company has established posts at various points in the United States, in Canada and in the United Kingdom, also at a few Continental points, and at several of Lloyds stations throughout the world. Various steamers have bought their apparatus, and travellers are now frequently able to keep in touch with the world during the whole passage across the Atlantic, by means of the Marconi apparatus on board other ships and at the shore stations. When Prince Henry visited the United States, he travelled on board a German steamer having a Marconi apparatus, and his approach-

ing arrival was duly notified to the world. When he returned to Germany, he was on board another German steamer furnished with the German Slaby-Arco apparatus. On approaching the Isle of Wight, the Marconi station at first communicated, and then, finding the apparatus of a rival on board, refused to take a message. Emperor William of Germany thereupon called a preliminary conference of the Powers to consider the matter. It was nearly two years before the day was actually fixed, principally because it was thought necessary in most countries to hold inter-departmental conferences to formulate an opinion on this complex matter, and meantime to allow this new discovery a little more time to develop. At length, the 4th of August was fixed and forty-three delegates were assembled, eleven being from Germany, three from Austria, three from Spain, three from the United States, six from France, four from Hungary, four from Italy, three from Russia. The proceedings were conducted in French, and the "*Avant Propos,*" or programme of discussion, consisted of a series of propositions and sub-articles covering the details of each. The first was to cover the point as to whether any company should be allowed to act as the Marconi Company had acted, and the others dealt with minor matters regarding distressed ships, tariffs, men-of-war, etc. Broadly speaking, the first was the only real question, the others being entirely subordinate, and there was much carefully prepared argument and discussion. On the one side, elaborate arguments were made to show that the Marconi Company really lead the world, and that, if their stations were compelled to receive messages from inferior apparatus, not only would they be unjustly injured in their interests, but the world's good service would be jeopardized: that it was too soon to think of formulating rules to fetter a new discovery in its development; and that, if the Marconi Company had won any advantage over their rivals, it was by fair business competition in which their rivals had been so far worsted.

On the other hand, it was held that the Marconi Company had declined to compete with any one else over the same proving-ground; that their claimed superior results were no better than those obtained by officers of the different governments there represented; that it was well known that other people could communicate as satisfactorily as Marconi could, and that it was not too soon to recommend the formulation of some rules which would

prevent the Marconi Company from developing a world monopoly which would stifle all independent research; the fact being that whereas cable companies only exploit telegraphy by means of cables, and do not manufacture cables or the apparatus for signalling, the Marconi Company were not only endeavoring to monopolize the exploitation of Wireless Telegraphy, but also of the apparatus by which such signals are made and received.

The discussion was very interesting; and, when it came to voting, the action of the various governments was a curious study. All the European nations have a government monopoly of all means of communicating information by electricity; and the vote of France, Germany, Austria, Hungary and Russia was prompt against the Marconi monopoly. Italy was in favor of the Marconi Company, being bound to it by a contract in consequence of Marconi's having, in Italy's opinion, the most perfectly organized system and the best apparatus. England held her decision in complete reserve; but signed the minority report with Italy, on the ground that, though the British Government had a monopoly of the telegraph, this authority was not supposed to extend beyond the marine league, and Marconi and every one else had a perfect right to operate Wireless Telegraphy between the coast and ships at sea, and make such rules as they chose regarding each other without interference from the government.

The United States delegation held, first, that the United States Government had paramount authority over any Wireless Telegraph association doing business either between the States of the Union or with foreign countries; and, second, that any such organization came under the common carrier law, which, by decision of the Supreme Court, compelled any one coming under that law to receive and transmit messages from any suitably equipped vessel or station. The vote of the delegates of the United States was thus cast with the majority.

Another very curious question raised and argued at great length was, whether the Marconi Company was entitled to an indemnity in case the recommendation of the majority became law. Italy was in favor of an indemnity. England would not admit an indemnity, but suggested that a surtax would be reasonable on all messages sent by rival apparatus. The other nations, including the United States, were against either an indemnity or a surtax, the idea of the United States delegates being that

neither the Marconi Company nor any one else was entitled to an indemnity or surtax because they had erected stations on our soil without having consulted our laws.

Minor matters, such as rates, and what part should go to the ship and what to the shore stations, were discussed *pro* and *con:* but, as the laws of the United States permit the utmost latitude in such matters, the United States delegates considered that business alone would ultimately regulate them, and that it was a matter of too small importance to discuss at the present time. The European nations held somewhat different ideas, because of their absolute control in such matters; but the general idea prevailed that the tariff should be equitable and in proportion to the telegraphic work done.

The work of such a Conference as this could be at best but preliminary, as its name indicates; but the result of the examination, for the first time, of the wireless telegraphic situation as it is to-day points very clearly to the advisability of a subsequent Congress, whose delegates shall be fully instructed and endowed with sufficient authority to go more deeply into the question in all of its relations.

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